ISSN 0-825-4591

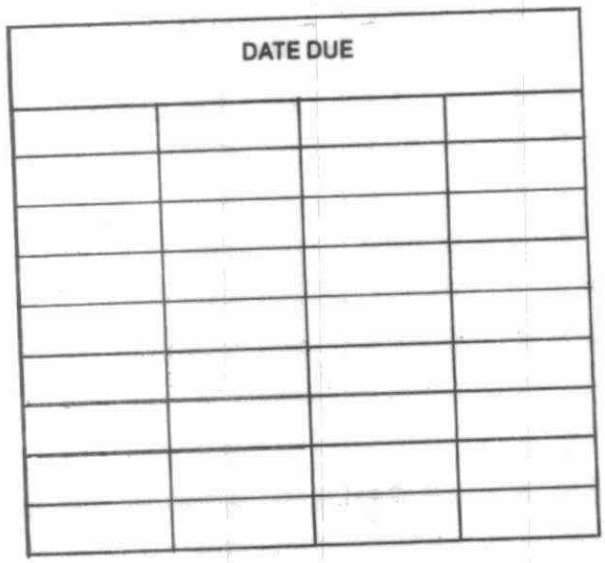
MINISTRY OF THE ENVIRONMENT

KEYNOTE PAPERS

TECHNOLOGY TRANSFER CONFERENCE

December 8 & 9, 1986

THE SHERATON CENTRE
TORONTO, ONTARIO,
CANADA



Paper No.		Page No.
	INTRODUCTION	1
I	CRUCIAL ISSUES IN ENVIRONMENTAL TOXICOLOGY ..... Gabriel Plaa Vice-Dean of Medical Research and Graduate Studies, University of Montreal Montreal, Quebec, Canada.	2
II	THE U.S.-E.P.A. APPROACH FOR CONTROLLING TOXIC SUBSTANCES AND FOR RISK ASSESSMENT..... James W. Falco Director Office of Environmental Processes and Effects Research, Environmental Protection Agency, Washington, D.C., U.S.A.	8
III	SOME INTERNATIONAL DEVELOPMENT IN ENVIRONMENTAL ASPECTS OF INDUSTRIAL AND TECHNOLOGICAL ACTIVITIES..... F. Roots Science Advisor Environment Canada, Ottawa, Ontario, Canada.	19

INTRODUCTION

The Ontario Ministry of the Environment holds its annual Technology Transfer Conference to report and publicize the progress made on Ministry-funded environmental and health-related research projects. These studies are carried out in Ontario universities and by private research organizations.

This booklet presents the Keynote papers presented at the Technology Transfer Conference, held in December 1986 and is complementary to Conference Abstract and Proceedings publications.

For further information on any of the projects, the reader is kindly referred to the Conference Proceedings, (ISSN 0-825-4591), or to the principal investigators.

Critical Issues in Environmental Toxicology

Gabriel L. Plaa, Ph.D.
Faculté de Médecine
Université de Montréal

ABSTRACT FORM

Author : Gabriel L. Plaa
Address : Faculty of Medicine, University of Montreal
Quebec, H3C 3J7 Phone (514) 343-6300
Co-Authors :

Topic Area : Air | |, Water | |, Waste | |, Analytical | |
Environmental Economics | |

Do you prefer presenting: A paper |x|, a poster session | |

Title: Crucial Issues in Environmental Toxicology

Abstract:

An overview on Environmental Toxicology will be presented including:

- the study of adverse effects of contaminants in air, water and soil;
- the biological targets of these chemicals including humans;
- subdivision of environmental toxicology; and
- toxicological assessment.

The dose-effect and dose-response relationships will also be discussed with emphasis made on the distinction between "toxicity" and "hazard" as well as exposure assessment.

Problems associated with chemical analyses, bioavailability, bioaccumulation, biotransformation relative to the chemical half-life and its translocation in air, water and soil will be summarized.

The review will also cover the climate of confrontation and adversal posturing, the problems associated with scientific credibility and the responsibility for the solution of the pressing toxicological issues.

1. GENERAL CONSIDERATIONS

Definitions

Environmental Toxicology

° The study of the adverse effects of chemicals found in the environment
  - The chemicals are found initially in the air, soil or water
  - Biological targets include humans as well as other species
° Interaction between environment, target organism and chemical
  - The chemical can modify the environment or the target organism
  - The target organism can modify the chemical or the environment
  - The environment can modify the chemical or the target organism

Ecotoxicology

° A subdivision of environmental toxicology

° Adverse effects on "populations", communities" and "ecosystems"
  - Has characteristics which differ from traditional toxicology
    . Traditional toxicology normally deals with individual organisms, not populations and communities
    . Traditional toxicology rarely deals with interactions between individuals or groups
° Toxicology assessment requires a mutidisciplinary scientific approach

2. DOSE-EFFECT AND DOSE-RESPONSE RELATIONSHIPS

Application

Apply to all divisions of toxicology, including environmental toxicology

History

Principle dates back to the 16th Century--Paracelsus

- All substances possess toxic properties; the dose determines if the toxicity will be manifested
- Dose (or exposure) conditions exist where toxicity will not occur

Distinction Between "Toxicity" and "Hazard"

"Toxicity" is a qualitative term that applies to all substances; all substances possess toxic properties

- One can quantify the dose (or exposure) where the toxicity will occur
- Toxicity may be "acute" or "chronic"
  - "Acute" toxicity is the result of a single or a few repetitive exposures
  - "Chronic" toxicity is the result of multiple, repetitive exposures

"Hazard" is the likelihood that the toxicity will occur in the manner the chemical is used

- The effective "dose" absorbed by the organism is the determining factor
- Conditions of exposure will determine the dose absorbed

Exposure to potentially toxic substances can occur without hazard

- The dose absorbed is sufficiently low
- The exposure is non-repetitive

3. PROBLEMS ASSOCIATED WITH CHEMICAL ANALYSES

Sensitivity

Analytical sensitivity for detection of the presence of chemicals

° Can quantify at the "parts per billion" and even "parts per trillion" level

° Can detect chemicals at levels that exert no biological activity

Presence and Biological Availability

Must differentiate between mere presence of chemicals

° Chemicals must be characterized in terms of potential for translocation; in air, water and soil
  - Chemicals firmly adsorbed into clay may be biologically unavailable
  - Chemicals present in water may or may not be biologically available

° Chemicals at the environmental site must be characterized in terms of persistence
  - Abiotic and biotic degradation
  - Chemical half-life in air, soil and water

° Chemicals must be characterized in terms of bioaccumulation
  - Biotransformation, excretion and storage in biological organisms

° Chemicals must be characterized in terms of biomagnification
  - Entry into the foodchain

4. THE CLIMATE OF CONFRONTATION AND ADVERSARIAL POSTURING

Problems Associated with Scientific Credibility

Prevailing attitudes do not lend themselves to knowledgeable exchanges

- Opinions of government scientists may be doubted
- Opinions of industrial scientists may be considered suspect
- Opinions of academicians may be questioned because of the source of research funding
- Scientists with insufficient toxicological knowledge evoke their opinions

Living in a Society of Litigation

Someone is responsible
Someone must pay, regardless of the circumstances

Climate Does Not Promote the Solution of Pressing Toxicological Issues

The United States Environmental Protection Agency's Program to Evaluate the Effects of Toxic Chemicals

James W. Falco
Director, Office of Environmental
Processes and Effects Research

Washington, D.C. 20460
United States

ABSTRACT FORM

Author : James W. Falco
Address : Office of Environmental Processes and Effects Research
Washington, D.C. 20460 Phone ( )
Co-Authors :

Topic Area : Air | |, Water | |, Waste | |, Analytical | |

Environmental Economics | |

Do you prefer presenting: A paper |x|, a poster session | |

Title: The United States Environmental Protection Agency's Program to Evaluate the Effects of Toxic Chemicals

Abstract:

The United States Environmental Protection agency conducts an extensive research program related to the control and evaluation of toxic substances. The Office of Environmental Processes and Effects Research is responsible for conducting the portion of this research which deals with the evaluation of toxics substances. Among its major programs, several shifts in research emphasis are taking place. First, there is a shift from development of methods which yield a single valued estimate of ecological effects. Secondly, increased emphasis is being placed on evaluating local ecological problems in addition to regional and national problems.

The Agency is currently emphasizing ecological effects research in 6 major areas: groundwater, biotechnology, wetlands, ecological risk assessment, acid deposition, and Great Lakes research.

GENERAL TRENDS IN ENVIRONMENTAL EFFECTS RESEARCH

The U.S. Environmental Protection Agency ascribes high priority to research on the evaluation of risks resulting from the release of toxic substances into the environment, and on control of these releases. Ecological effects research is becoming more prominent because of our limited understanding of the relationship between releases and these effects, and equally importantly because of our limited ability to mitigate these effects once releases have occurred. The Office of Environmental Processes and Effects Research is targeting the research of six of its major programs to respond to this shift in emphasis.

In the past, research related to control of toxic substances has largely dealt with minimizing chemical releases. With regard to effluent wastes, recycling and the treatment of waste streams have been emphasized. Restrictions of the application of pesticides to specific crops and limitations on the amounts of these applications have been stressed in pesticides cases. Hazardous solid wastes research has given weight to containment and the destruction of chemicals. Relatively little effort has been directed toward controlling the temporal and spatial distribution of these releases.

Similarly, toxicological and ecological effects research has focused on the development of methods that assess the acute effects resulting from short duration high exposures, and the chronic effects resulting from long-term steady-state exposures. The frequent result of applying these methods to specific problems has been the establishment of ambient air, water, soil or sediment concentrations, that are not to be exceeded. Permitted discharge rates or application rates are often back calculated so that the ambient concentrations prescribed are not exceeded.

It is important to develop methods that assess the toxicological and ecological effects resulting from frequent but short exposures to chemicals above prescribed levels, which produce measurable effects over long exposure durations. To date, relatively little effort has been geared toward this kind of research. Increasingly, research related to developing methods to estimate environmental effects will focus on probabilistic methods, as opposed to single point value estimates.

Research that characterizes the behavior of chemicals in the environment will likewise shift from estimations of average long-term ambient concentrations to specifications of frequency and duration of occurrence of a range of concentrations. Uncertainty in these ambient concentrations will be characterized by frequency and duration curves that represent upper and lower confidence intervals. Development of the probabilistic analyses is well underway and will continue over the next few years.

During this time period, EPA will give increased weight to the development of probabilistic techniques to estimate effects resulting from exposure as well. These techniques are not as highly developed as the techniques used to predict the behavior of chemicals in the environment. Consequently, a great deal of conceptual work must be carried out before practical approaches can be developed. At this time, studies are underway to define the behavioral patterns of animals exposed to toxic chemicals. These behavioral patterns may significantly alter exposure opportunities.

EPA is also undertaking significant studies of the effects on organisms--both plants and animals--that result from exposures to two or more simultaneous stresses. The goal of this research is the capability to predict adverse impacts on

animals and plants species that may result from exposures to multiple stresses, some of which may occur naturally.

Ecological effects research is currently developing methods to predict toxic ecological effects on a local scale. The Toxic Substances Control Act and other Federal legislation of the mid 1970's were directed toward the protection of the environment from exposure to toxic chemicals. These laws ascribed particular import to methods to be used on a national or regional scale. The passage of the Resources Conservation and Recovery Act and the Comprehensive Environmental Response Compensation and Liability Act, and subsequent implementation of these acts, has necessitated more emphasis on methods intended for use on a local scale.

Foreseeabley, early efforts in this vein have essentially been extrapolations of previous experiences on national and regional scales. To a large degree, researchers have abstracted the techniques that apply to evaluations of local ecological effects, but attention is starting to focus on the development of new methods that specifically address local problems. Efforts to date have been concentrated on the development of relatively inexpensive assays which can be economically applied to a large number of local problems. So far, the conceptual basis that exists to evaluate locally contaminated sites is limited; therefore, results obtained from these tests cannot be used to their full potential.

The emphasis shifts discussed above outline broad general approaches which pertain to major segments, if not to the entire toxics research program. Brief descriptions follow of six specific research programs that address major EPA problems related to the control of toxic chemicals in the environment. EPA is increasingly affirming the importance and timeliness of these programs, and they are expected to receive increased support in the next few years.

GROUNDWATER RESEARCH PROGRAM

The major focus of the groundwater research program is to characterize the behavior of chemicals released into groundwater. Individual research projects have been initiated to address certain major issues. A number of projects are devoted to developing the models that predict the movement of chemicals in subsurface environments. The movement of chemicals through heterogenous media cannot as yet be adequately characterized. This is a major impediment which must be overcome if practical models are to be developed. The currently available models that can accurately predict chemical movement in subsurface media require the collection of large amounts of costly data over lengthy time intervals. Existing models that are simpler, and which do not require collection of large amounts of data, have limited accuracy and precision.

Several research projects have been initiated to characterize the chemical and biological reactions that chemicals undergo in subsurface environments. While there has been good progress with regard to chemical reactions, improvements in researchers' ability to predict rates of biological reactions have been limited. Recent advances by EPA's Ada, Oklahoma Laboratory have improved the capability to predict biodegradation rates of the more readily degradable hydrocarbons, but a great deal of effort is still necessary on the characterization of the biodegradation processes that are involved in the breakdown of more refractory organic compounds.

Finally, EPA is devoting some effort to new methods to treat chemically contaminated groundwater in situ. These studies have focused on altering subsurface environmental conditions to enhance biodegrading of the chemicals which contaminate groundwater. Although limited-scale demonstrations of the

feasibility of such methods for compounds such as Trichloroethylene (TCE) have been successful, practical applications of these techniques to a wide variety of contaminated sites will require further research.

BIOTECHNOLOGY RESEARCH PROGRAM

EPA started the biotechnology research program in 1985. The initial impetus was toward developing methods to detect genetically-engineered organisms after these have been released into the environment. Detection methods to determine the sensitivities of various methods and detection limits are currently being tested in field studies.

As adequate detection systems are developed, the weight of the Agency's biotechnology program will shift to developing methods that estimate ecological effects related to the release of genetically-engineered organisms. A wide variety of techniques that evaluate effects of exposure to naturally occurring bacteria and viruses currently exist. These existing methods are logical antecedents for methods to assess ecological effects related to the release of genetically-engineered organisms.

THE WETLANDS RESEARCH PROGRAM

During this past year, the Environmental Protection Agency initiated a program to improve its permits process under Section 404 of the Clean Water Act. One of the goals of this Act is to evaluate the broad range of functions served by wetlands, and to protect the functions which are vital. The program has three major goals:

- To establish the relationship between toxic chemical releases and water quality;

- To develop methods to assess and predict cumulative impacts of losses of wetlands; and
- To develop and evaluate methods to mitigate incremental and cumulative impacts.

EPA plans to focus water quality research on the uptake, the transformation, or the addition of materials, as water containing these materials flows through wetlands. The Agency is beginning an experimental program to define these processes and estimate the rates at which they occur in a wide variety of wetlands types. Large scale systems or mesocosms will be used to improve the degree to which study results may be extrapolated to larger ecological units.

Research on cumulative impacts will be based on surveys of past losses of wetlands by type and geographical location, and on correlations of losses with impacts. Clearly, thresholds of losses which would trigger dramatic changes in wetlands functions are of particular interest. Methods to detect such "break points" or thresholds will be developed.

Mitigation research plans include developing methods to enhance wetlands habitat values, improving existing methods of restoring highly disturbed wetlands, and guiding the design of effective mitigation projects. The Agency will evaluate major alternatives including impact avoidance, impact minimization, on-site compensation and off-site compensation. Efforts will be made to review past projects, and to participate in current projects where it is feasible to conduct experiments to test mitigation techniques.

The decision to base our wetlands research on the three narrowly-defined objectives described reflects the fact that a number of United States agencies are engaged in wetlands research. The Environmental Protection Agency's effort will be closely coordinated with those of these other agencies, to

ensure that the results are achieved with maximum efficiency, and are formatted for easy interpretation and use throughout the Federal Government.

ECOLOGICAL RISK ASSESSMENT PROGRAM

In 1985, EPA began the ecological risk assessment program to improve capabilities to assess environmental impacts related to the introduction of pesticides and other toxic chemicals. The program was significantly expanded in 1986, and will continue in 1987 and 1988. This program's research spans the range of aspects of ecological risk assessment from validating effects test methods to developing an improved basis for conducting assessments.

EPA established the conceptual basis for ecological risk assessments shortly after the Agency's formation, and it has not undergone any major revision in several years. Since that time, new techniques, improved models and more efficient test methods have been developed, which have been applied on a case-by-case basis. This has opened the Agency to the criticism that it is not applying a uniform conceptual view to all of its ecological risk assessments. Perhaps the most important contribution of this program therefore, will be an updated overall conceptual basis.

Major data bases are being assembled which characterize ecosystems and contain information such as chemical avoidance habits by terrestrial, aquatic and avian species. The data sets included will be formatted to be compatible for use with ecological effects models, and other evaluation methodologies. These data bases will be integrated with the data bases currently used by the Agency, in order to enhance the information available to those conducting ecological risk assessments.

Finally, laboratory test methods as predictors of ecological effects will continue to be validated as part of this program. Such test methods must always balance the resources required to conduct the test versus the uncertainty inherent in the extrapolation of test results to actual environmental situations. Field validation studies pursued under this program should provide sound estimates of these uncertainties, and hopefully will improve the extrapolation methods that are used in conjunction with these laboratory test methods.

ACID DEPOSITION EFFECTS PROGRAM

The Acid Deposition Effects Program is currently evaluating the effects of exposure of aquatic and terrestrial ecosystems to constituents contained in acid rain.

With regard to aquatic effects, surveys of variations in water chemistry which may alter the impacts of acid deposition will be continued across the country. Surveys of soil data collected in the Eastern United States will also be continued. As in the water chemistry studies, the soil parameters that may alter the impacts of acid deposition on aquatic biota within a watershed are being investigated.

In the terrestrial effects area, the effects of acid deposition on spruce/fir, southern commercial, eastern hardwood and western coniferous forest types will continue to be investigated. There will be increased weight on the investigation of effects resulting from exposures to a combination of chemical agents, as opposed to single agent exposures. A vegetation survey and a central synthesis and integration project are being undertaken to support this effort.

GREAT LAKES RESEARCH PROGRAM

The Great Lakes Research Program is comprised of two major studies, the first of which relates to in-place toxic pollutants. In order to determine the persistence of pollutants, the internal circulation and slow transformation processes which degrade toxic chemicals assume more relative importance in the Great Lakes than in smaller water bodies. This is due to the great retention time of the lakes. Because of their importance, a combination of laboratory, field and modeling studies are being conducted to accurately define these processes, and to estimate the rates at which they occur. The second, related study is attempting to measure the movement of toxic chemicals through the connecting channels between the lakes. The information collected in these studies is necessary to perform mass balances on each of the lakes for chemicals of interest.

In addition to these research studies, the Agency provides a significant amount of technical assistance to Regional Offices of the United States Government that are involved with the Great Lakes, to the International Joint Commission and to the Great Lakes states.

Some International Developments in Environmental Aspects of Industrial and Technological Activities

E.F. Roots
Environment Canada
Ottawa, Ontario

ABSTRACT FORM

Author : E.F. Roots
Address : Environment Canada, Ottawa, Ontario, K1A OH3
Phone (819) 997-2393
Co-Authors :

Topic Area : Air | |, Water | |, Waste | |, Analytical | |

Environmental Economics | |

Do you prefer presenting: A paper |x|, a poster session | |

Title: Some International Developments in Environmental Aspects of Industrial and Technological Activities

Abstract:

Recent international developments reflect the increasing importance of environmental factors in economic activities and can be expected to affect industrial enterprises and technological development in Canada and other countries. In 1984, the Heads of State of the seven Economic Summit countries - Canada, France, Italy, Japan, U.K., U.S.A., West Germany - and the European Economic Community recognized the importance of environmental quality to economic prosperity. They instructed the Working Group on Technology, Growth and Employment (TGE) to review areas where environmental factors were most important to future economic development, and to make recommendations for international and industrial action.

In its report to the 1985 Economic Summit in Bonn, the TGE identified major areas where environmental conditions have a significant present or potential influence on technology, economic performance or employment. It recommended policy actions to being environmental management into industrial practices, and identified 62 subjects where additional research or development of environmental control measures or technologies as needed, in six main categories of environmental concern: air pollution, toxic and hazardous wastes, pollution of streams and groundwaters, marine pollution, inappropriate land husbandry, and climate change. It also noted that there was an important need for improvement and international harmonization of the techniques and practices of environmental measurement, so that environmental data could become more reliable and comparable, and to avoid environmental issues becoming unjustified factors in international trade because of incompatible information.

The TGE Environment Group has further studied this problem. Together with international scientific bodies it has developed general principles for environmental measurement and identified specific subject areas where improved scientific understanding or technique development is needed, and areas where improved management of environmental information is needed. A progress report was accepted by the 1986 Economic Summit in Tokyo and the Group is now preparing, for presentation to the 1987 Summit in Rome, a proposal for an on-going mechanics, under the authority of an established international organization, for achieving continuing improvement of environmental data in ways that are relevant to new technologies and industrial processes.

(continued).....

At the same time, the International Council of Scientific Unions' Committee on Data for Science and Technology (CODATA) has become concerned about the shaky scientific basis of much environmental data. The first CODATA workshop on environmental data was convened in Montreal in May 1986, "Directions for Internationally Compatible Environmental Data", with representatives from 19 countries and 32 different national or international standards or scientific data organizations. The workshop identified areas of weakness or incompatibility in basic data or measurements pertaining to air, water, and soil, and explored environmental data management needs on various scales for different uses: global understanding, regional management, regulatory, and environmental assessment.

These two developments, together with the evolution of the World Data Centres whose role was re-examined at the ICSU General Assembly at Berne in September 1986 mark important progress, supported at the highest political and scientific level, in the fundamental questions of measuring the characteristics of the environment and the setting of environmental standards. Their effects may be expected to influence nearly every laboratory or industrial process that uses natural resources or has an effect on the environment.

TECHNOLOGY TRANSFER CONFERENCE 1986

Organized by ***RESEARCH ADVISORY COMMITTEE***
J. Pagel, Chair

Sponsored by ***CORPORATE RESOURCES DIVISION***
A. Castel, Executive Director

CONFERENCE COMMITTEE:

	M. Moselhy	***Co-ordinator***
Environment Ontario:	D. Bartkiw	G. Rees
	W. Chan	R. Reguly
	J. Donnan	G. Ronan
	D. McTavish	C. Schenk
	E. Piché	
Labour Ontario:	G. Wright	
Health Ontario:	L. Smith	
Environment Alberta:	H. Sims	
Environment Québec:	H. Saint-Martin	
Environment Canada:	F. Hurtubise	K. Shikaze
	B. Jank	
University of Waterloo:	J. Cherry	
Lakehead University:	G. Ozburn	
Goodfellow Consult. Inc.:	H. Goodfellow	
Zenon Environmental Inc.:	A. Benedek	

Communications:	T. Gorsline	C. Labonté
Poster Session:	H. Eijsenck	
Spouse Program:	Ann-Marie Clarke	